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Comparison of Chorionic Ultrastructure in Eggs of *Attacus* and Allied Genera (Lepidoptera, Saturniidae)

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Synopsis Chorionic ultrastructure of eggs were examined of six species of *Attacus* and one species each of *Coscinocera* and *Archaeoattacus*. Intrageneric differences between eggs of *Attacus* species were not very strong; intergeneric differences between eggs of these three Indo-Australian genera were very conspicuous. Eggs of *Attacus* have honeycomb-like fossae surrounded by tiny aeropyles. The micropylar region is not distinctive from remaining regions of the chorion. Eggs of *Archaeoattacus* have tulip-like processes on the lateral surfaces closely resembling those recently found in *Antheraea pernyi* by other workers. Eggs deposited by females are highly preferable for study over those extracted from abdomens of dried specimens.

Introduction

The use of chorionic structure as a taxonomic tool in the study of Lepidoptera has been known for many decades. Recent studies such as the important one by DOWNEY and ALLYN (1981) show the ultrastructure of the lepidopteran egg to be complex and of value in elucidating phylogenetic relationships. Among the Saturniidae, DÖRING (1955) figured and described eggs of five European species, and REBEL (1925) illustrated chorionic surfaces of eggs *Samia* HÜBNER. JOLLY (1981) gave diagrams of follicular imprints on eggs of eight species of *Antheraea* HÜBNER. The studies of REBEL, DÖRING, and JOLLY utilized light microscopes. Much greater detail becomes available through usage of scanning electron microscopes (SEM), as seen in the paper on eggs of Lycaenidae by DOWNEY and ALLYN and another on *Antheraea* by KAWAKAMI *et al.* (1980). Chorionic ultrastructure has not been described or figured for any genera of Saturniidae besides *Antheraea* as far as we are aware.

The present study developed as a portion of a long term project on the genus *Attacus* LINNAEUS by the senior author (PEIGLER, 1983). This is a report on some observations made on six species of *Attacus* and on one species each of the allied

genera *Coscinocera* BUTLER and *Archaeoattacus* WATSON. All three genera have relatively large, non-diapausing eggs. Those of *Attacus* have dimensions measuring within the following, depending on species: length 2.5–3.2 mm, width 2.2–2.9 mm, height 1.5–2.2 mm. Eggs of *Coscinocera* are equally large whilst those of *Archaeoattacus* have all dimensions less than 2.0 mm.

Materials and Methods

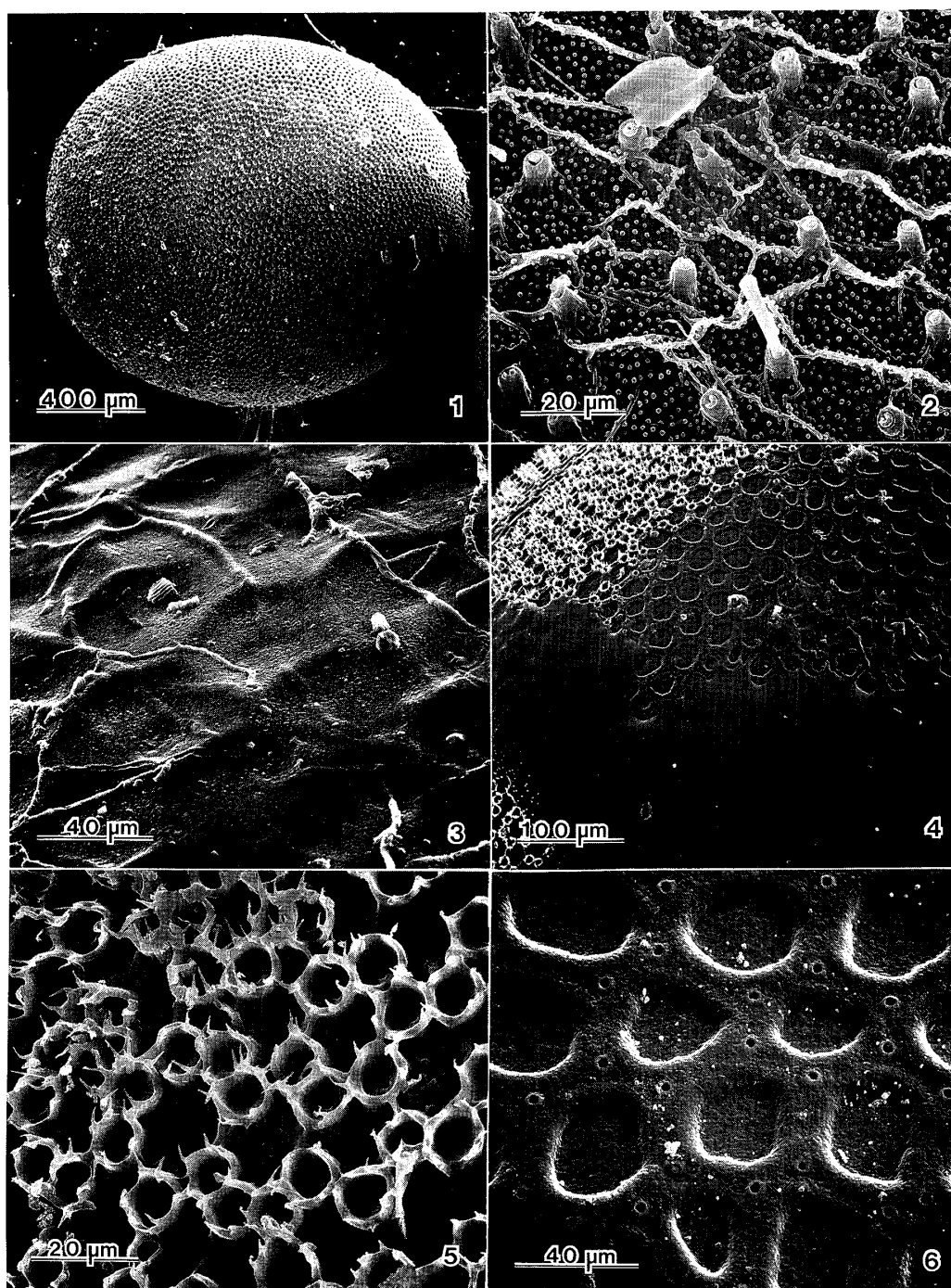
The species and source localities of which eggs are figured in the present paper are *Attacus atlas* (LINNAEUS) from West Malaysia (Fig. 11) and Taiwan (Fig. 12), *A. aurantiacus* W. ROTHSCCHILD from the Key Islands, *A. caesar* MAASSEN from Mindanao, *A. crameri* C. FELDER from Ambon, *A. erebus* FRUHSTORFER from Celebes, *A. lorquinii* C. & R. FELDER from Marinduque Island, *Archaeoattacus edwardsii* (WHITE) from northeastern India, and *Coscinocera anteus* BOUVIER from New Guinea. Eggs were obtained by two methods. For *A. atlas* from Taiwan, *A. lorquinii*, *A. caesar*, and *A. edwardsii* eggs were available which had been deposited by living females. The ova for all remaining species and *A. atlas* from West Malaysia were extracted from the abdomens of pinned females.

The SEM examination of the egg chorions was conducted at the Texas A&M University Electron Microscopy Center. Jeol JSM U-3 and U-35 SEM's were used at 15 kV and 25 kV respectively. Prior to examination the material was dessicated in a glass dessicator containing anhydrous calcium sulfate crystals for several days. After dessication the eggs were mounted on aluminum specimen stubs with either silver paint or double stick tape. The mounted eggs were then given a 150–350 Å coating of gold-palladium using a Hummer sputter coater.

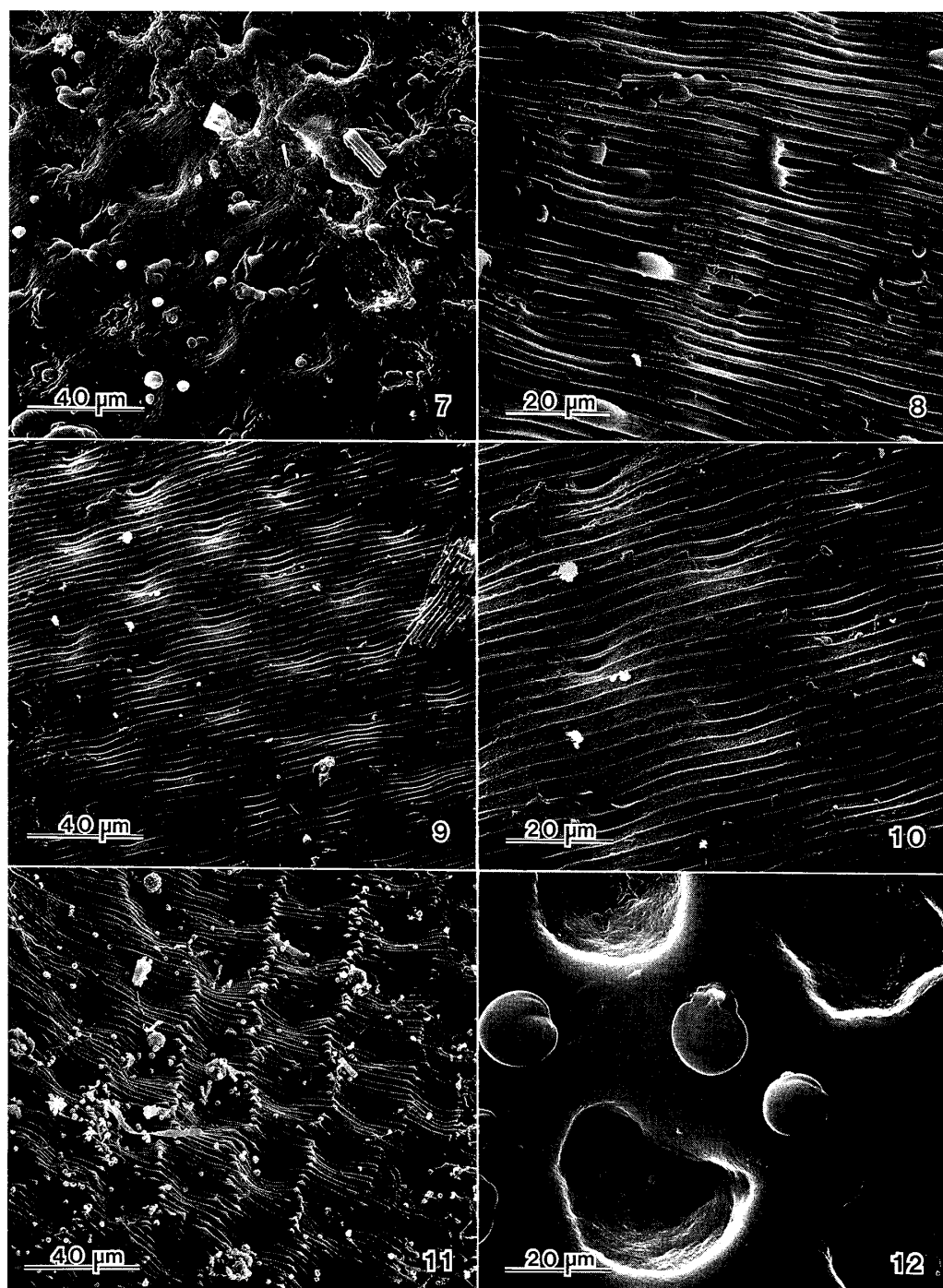
Results

It was found that extraction of eggs from the abdomens of dead females is not a satisfactory method of obtaining material for study. Although the total complement of eggs appears to be fully formed when female saturniids emerge from their cocoons, our observations reveal that those eggs which are deposited naturally are highly preferable for study and description. Unlaid (extracted) eggs of *Attacus* are invariably covered with parallel strands which are probably part of the epithelial lining of the ovarian follicles. Although these strands appear to possess in themselves interesting and species-specific characters, they probably conceal more important characters such as aeropyles and fossae which are seen easily on deposited eggs. Similar observations and conclusions were made on eggs of Lycaenidae by DOWNEY and ALLYN (1981). Our figures of *A. aurantiacus* (Figs. 1, 13, 14), *A. erebus* (Figs. 2, 7, 8), *A. crameri* (Figs. 9, 10), and *A. atlas* (Fig. 11) show these strands clearly. Moreover, extracted eggs are frequently contaminated with tissue fragments from inside the female (see Figs. 3 and 7).

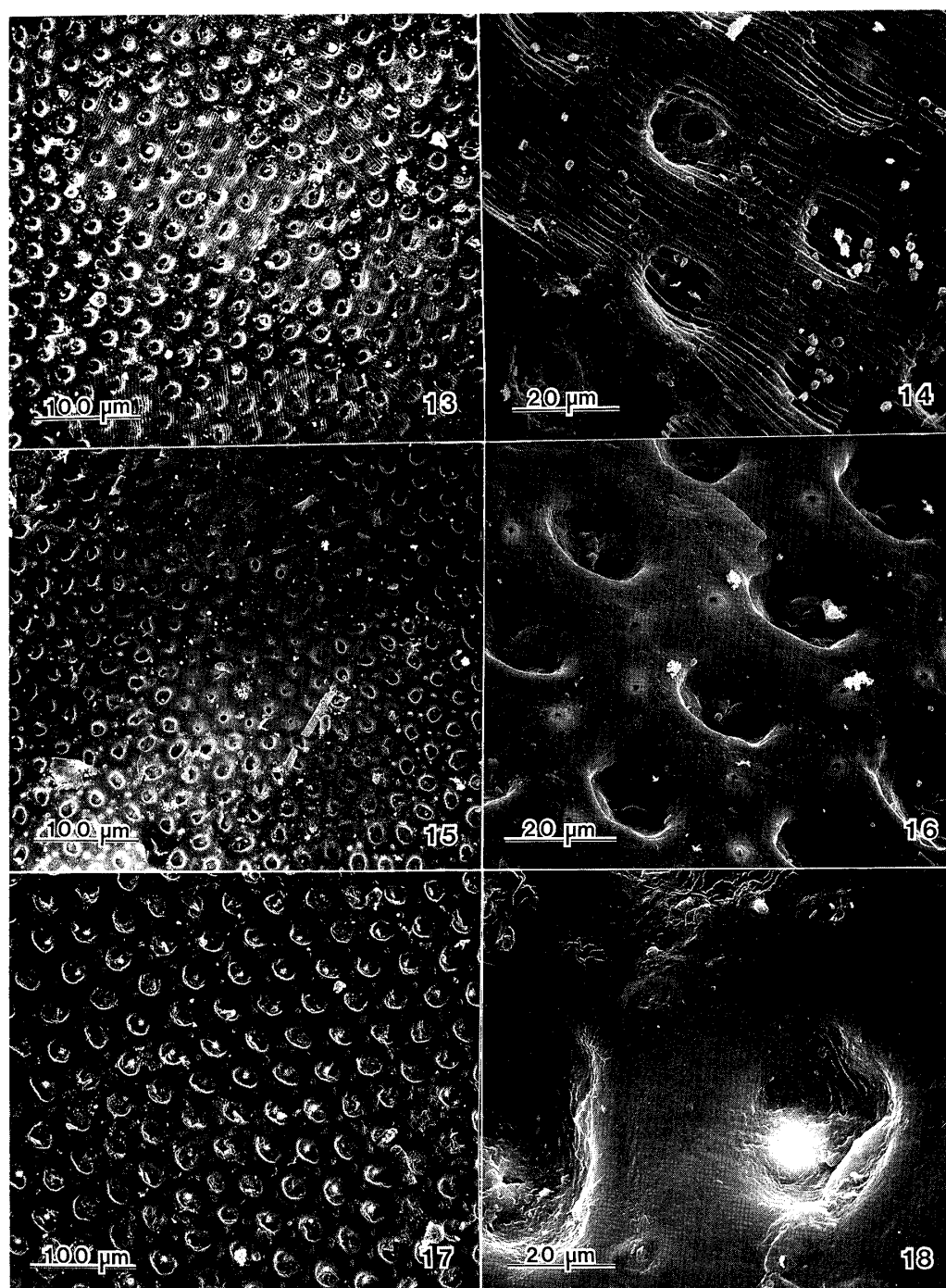
When the female moth oviposits, she secretes a fluid from her accessory glands to



Figs. 1-6. 1. *Attacus aurantiacus*, entire egg (48 \times); 2. *Attacus erebus*, showing stalked aeropyles (1000 \times); 3. *Coscinocera anteus* (540 \times); 4-6. *Archaeoattacus edwardsii*; 4. Showing excessive deposit of accessory gland secretion (200 \times); 5. Showing tulip-like processes (1000 \times); 6. (580 \times).



Figs. 7-12. 7-8. *Attacus erebus*; 7. (540 \times); 8. (1000 \times); 9-10. *Attacus crameri*; 9. (540 \times); 10. (1000 \times); 11-12. *Attacus atlas*, extracted vs. deposited egg; 11. W. Malaysia (540 \times); 12. Taiwan (1000 \times).



Figs. 13–18. 13–14. *Attacus aurantiacus*; 13. (200 \times); 14. (1000 \times); 15–16. *Attacus caesar*; 15. Showing micropylar region (200 \times); 16. (1000 \times); 17–18. *Attacus lorquinii*; 17. (200 \times); 18. (1000 \times).

affix the eggs to a substrate (usually the hostplant). This secretion also completes the formation of the chorionic structure (DOWNEY and ALLYN, 1981). The fluid permeates over the entire surface of the chorion, filling openings and making the surface smoother (Figs. 12, 15 – 18). Sometimes excessive quantities of the fluid cover portions of the egg (Fig. 4); the reddish brown blotching is seen commonly without magnification on eggs of many Saturniidae.

In *Attacus erebus* (Fig. 2) and *A. atlas* we observed stalked or volcano-like aeropyles not unlike those found in a few lycaenids by DOWNEY and ALLYN (1981). If the function of these structures is to permit respiration through the chorion, their raised walls are possibly in response to the coating of accessory gland fluid discussed above or to excessive moisture subjected to these eggs in nature in their rainforest biotopes. The micropylar region of the egg of *Attacus* does not appear distinctive (Fig. 15), although it is so for many or most Lepidoptera (DÖRING, 1955; DOWNEY and ALLYN, 1981).

Ultrastructure of chorion in *Archaeoattacus* supports generic separation of this group from *Attacus*. Eggs of *Archaeoattacus* (Figs. 4 – 6) have honeycomb-like fossae as do those of *Attacus*, but also have structures closely resembling those in *Antheraea pernyi* (GUÉRIN-MÉNEVILLE) shown by KAWAKAMI *et al.* (1980) and referred to by them as “tulip-like processes”. The observed similarity in the appearance between eggs of *Antheraea pernyi* and *Archaeoattacus edwardsii* is unexpected because *Antheraea* belongs to the tribe Saturniini whilst *Archaeoattacus* belongs to the Attacini along with *Attacus* and *Coscinocera*. It is thus an interesting case of convergence, probably of ecological instead of phylogenetic origin.

No aeropyles were observed on eggs of *Coscinocera*. Aeropyles are visible as openings between honeycomb-like fossae on eggs of *Attacus* and *Archaeoattacus*. Deposited instead of extracted eggs of *Coscinocera* are needed to make valid comparisons.

Saturniidae are reared around the world more widely than any other insects. Deposited eggs of numerous species are easily available. It is our hope that this paper will stimulate other workers to investigate and illustrate chorionic ultrastructure in additional genera of Saturniidae. Such data will be useful in studies attempting to determine phylogenetic relationships, and may also yield interesting ecological information.

Acknowledgments

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